Remarks

This is in response to the Non-final Office Action dated 11/04/2002.

Claims 1-12 remain in the application.

The Office action rejects claims 1-12 under 35 U.S.C. 102(a) as being unpatentable over Nishi et al.(U.S. Pat. No. 5,724,126). Reconsideration of this rejection is respectfully requested.

The instant invention provides a method and apparatus for measuring chromatic dispersion in optical fibres. The chromatic dispersion, which is equal to the rate of change of group delay with respect to wavelength, is measured by modulating the output from a laser (e.g., a tunable laser diode) and sending it through an optical fibre so that the modulation of the pump signal is impressed upon another optical signal (i.e., the probe signal) passing through the same optical fibre. This modulation transfer is measured and is used to calculate the dispersion as a function of wavelength. The measured dispersion, which is a combination of material dispersion and waveguide dispersion, corresponds to the dispersion averaged over the fiber.

Nishi et al. disclose a method and apparatus for measuring the distribution of zero dispersion wavelengths in an optical fiber. A zero dispersion wavelength is a wavelength, or wavelengths, at which material dispersion and waveguide dispersion cancel one another out. As Nishi et al. discuss, for example in column 1, lines 49-53 and/or in column 2, lines 32-60, measuring the *distribution* of dispersion values is more difficult than measuring *average* dispersion values. To overcome this difficulty, many methods, including the one proposed by Nishi et al. include an optical time domain reflectometer (OTDR).

It is submitted that the method and apparatus proposed by Nishi et al. measures a different property than what is measured with the instant invention, as defined in claims 1-12. With explicit reference to claim 1, the instant invention is

defined as a method for measuring group delay (from which the average dispersion may be calculated). Nishi et al. disclose a method of measuring distributed zero-dispersion wavelengths. Nishi et al. do not measure group delay.

The rejection of claims 1 and 4 are further traversed for the following reasons:

a) Claims 1 and 4 specify that the instant invention includes the step of inputting a *modulated* narrowband *pump signal* into the input end of the waveguide *to generate Raman gain.* Nishi et al. do not disclose using a modulated pump signal to generate Raman gain. Referring to Fig. 16, column 18, lines 0-5, and column 3, lines 33-45, Nishi et al. disclose a pump source, which may be a sequence of pulses, for amplifying an optical pulse based on modulation instability induced by the pump light. As is well known in the art, modulation instability and Raman gain are different phenomena. At column 2, lines 50-55 Nishi et al. disclose *a prior art* method of determining a distribution of values using Raman interaction. The method and apparatus proposed by Nishi et al. do not utilize Raman interaction.

b) Claims 1 and 4 further specify that the method includes the step of impressing the modulation of the pump signal on the probe signal through temporal and spatial Raman gain modulation in the waveguide. Nishi et al. do not disclose this modulation transfer. With reference to Fig. 16, at column 17, lines 32-64, Nishi et al. teach that the optical pulse and pulsed pump light are synchronized with each other. There is no modulation transfer. In fact, Nishi et al. teach away from the instant invention by providing a pulse signal, or if the pump is pulsed, two pulse signals. In the instant invention, the probe signal is a continuous signal upon which the modulation of the pump signal is impressed.

c) Claims 1 and 4 further specify the step of *varying the modulation frequency* of the pump signal. Nishi et al. do not teach varying the modulation frequency of the pump signal. At column 3, lines 45-50, Nishi et al. teach that the pump light wavelength is swept. It is submitted that varying the frequency at which the pump is modulated

(e.g., sinusoidally modulated) is different than changing the wavelength of the pump. Notably, the instant invention as defined in claim 4 includes the steps of varying the modulation frequency *and* sweeping through a range of wavelengths, as for example, shown in steps e) and i).

d) Claims 1 and 4 further specify that the method includes the step of measuring the frequency response of the probe signal at the output end of the waveguide while the modulation frequency of the pump signal is varied. It is submitted that Nishi et al. do not vary the modulation frequency, as discussed above. Furthermore, it is submitted that it would not be obvious to measure the frequency response of the probe signal, since they do not teach a modulation transfer between the pulse (c.f., probe) and pump.

e) Finally, claims 1 and 4 include the step of determining the group delay from the frequency response of the probe signal. As discussed above, Nishi et al. do not measure nor calculate the group delay. With respect to column 1, lines 25-30 Nishi et al. discuss prior art methods of measuring group delay.

Since Nishi et al. do not teach the elements discussed above with respect to claims 1 and 4, these claims are believed to be allowable. Claims 2-3 and 5-6, which depend from claims 1 and 4, respectively, are thus also believed to be allowable.

With respect to claims 2, 5, 9, it is submitted that it is not obvious to modify Nishi's method with a known separating means. In fact, since the method and apparatus taught by Nishi et al. includes an OTDR for measuring back-reflected light waveforms, it is unnecessary to separate the probe signal from the pump signal at the output end of the waveguide.

With respect to claim 3, it is submitted that the use of the equation for calculating relative group delay, and hence average dispersion, is novel and inventive. In particular, it is novel to use the normalized frequency response to calculate the

group delay. Notably, the use of this equation in the method and apparatus taught by Nishi et al. would not result in the instant invention. In particular, Nishi et al. do not teach varying the modulation frequency of the pump, f, where $f = \omega / 2\pi$ (see Eq. 1).

With respect to claim 4, please see the discussion above.

It is further submitted that Nishi et al. do not teach an apparatus as defined in claim 7. In particular, Nishi et al. do not disclose an apparatus for measuring chromatic dispersion of a waveguide having an input end and an output end, wherein at the input end a source of Raman pump light and a modulator for modulating the Raman pump light are disposed, and wherein detector means for detecting and measuring a frequency response of a probe light is disposed at an output end. In fact, Nishi et al. provide detector means near the input end so that they can monitor modulation instability induced by the pump light (i.e., measured from the back-scattering light waveform). Providing detector means near the input end does not permit the measurement of modulation transfer between a pump light and probe light launched into the input end. Accordingly, it is submitted that the instant invention as defined in claim 7 is inventive over the method and apparatus taught by Nishi et al. Furthermore, claims 8-12, which depend from believed allowable claim 7, are also believed to be in allowable form.

Applicants sincerely believe that the above Remarks place this case in condition for allowance, and a holding to this effect is respectfully solicited. If, however, the Examiner believes that any issue(s) remains, they are sincerely requested to call Applicant's undersigned attorney of record so that a brief interview may be arranged for resolving any such remaining issues.

As this response has been timely filed within the set period of responses, no petition for extension of time or associated fee is required. However, the Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment, to Deposit Account No: 50-1465.

Respectfully submitted,

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